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Rear-End Crash Warning Systems: A series of projects is being conducted to support the field operational test of a rear-end crash avoidance system.

- **National Highway Traffic Safety Administration (NHTSA) Algorithm Studies:** This project uses radar data collected in previous studies to improve the theoretical algorithm used by NHTSA to activate rear-end crash warning display systems. The purpose of this project is to identify conditions under which warning mechanisms should be disabled in order to reduce the occurrence of false alarms. Mitretek has finished this study and results are forthcoming in the form of conference papers.

- **NHTSA Algorithm Encoding:** The objective of this initiative is to prepare a real-world computer algorithm for Forward Crash Warning in order to study the effectiveness of implementation options. To accomplish this, NHTSA first developed a theoretical computer algorithm, which is here translated and encoded into a software language suitable for the car's computer. Then the algorithm is tested and refined. This quarter, final enhancements and fixes were made to the NHTSA algorithm, testing was performed, and a draft report is almost complete.

- **Forward Crash Warning and Adaptive Cruise Control Driver Vehicle Interface Optimization:** The University of Iowa is working to optimize the interface between the vehicle and the driver for an integrated Forward Crash Warning and Adaptive Cruise Control system. A research plan was under development in this quarter.

- **Forward Collision Warning:** This project is an extension of the preliminary alert timing and alert requirements developed in the previous cooperative agreement between USDOT and the Crash Avoidance Metric Partnership (CAMP). The current project involves two major lines of research. One focus is to obtain additional "normative," baseline data in order to better define crash alert timing requirements under a wider range of conditions than were examined in the previous CAMP program (e.g., lead vehicle moving at a constant speed, lead vehicle decelerating at non-constant levels, and nighttime conditions). A second focus is to better understand the relationship between data obtained employing the CAMP surrogate target methodology under closed-course conditions and data obtained with the National Advanced Driving Simulator (NADS). More specifically, this effort examines the relationship between last-second braking maneuvers and lane-change maneuvers with the CAMP closed-course versus NADS approach. An annual report is forthcoming from CAMP to describe this work.

- **Field Operational Test:** General Motors and Delphi-Delco Electronic Systems are working with several subcontractors to develop a Forward Collision Warning system. The prototype development and all design verification testing were successfully completed in January. For this field test, the prototype was outfitted with a heads-up warning display, forward vision sensor, radar sensors, and Adaptive Cruise Control. The annual report for this project is available at: http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE/13676.pdf.

Road Departure Crash Countermeasures: Road departure crashes can occur, for example, when a driver is going too fast for a curve in the roadway ahead, or a driver falls asleep at the wheel and drifts off the road. The following projects were active this quarter.

- **Driver Performance in a Lateral Departure Scenario:** The NHTSA Vehicle Research and Test Center is studying driver performance in lateral road departure situations. Drivers on a test track with a foam wall were asked to 'steer at the last second' to avoid colliding with the wall, which was painted to realistically resemble concrete. The objective was to determine the last-second safety margin that aware drivers leave with such an obstacle in order to gain insight for warning algorithms. This testing was completed this quarter and a report will be available soon.

- **Naturalistic Road Keeping on Rural Roads:** Under this study, the NHTSA Vehicle Research and Test Center will be preparing specially equipped test vehicles with recording devices to better understand when drivers naturally steer and brake. The purpose of this study is to determine the 'too early boundary,' or the earliest point at which public drivers begin to react to various roadway conditions. This information will provide insight for the development of warning algorithms. This initiative is currently in the planning stages.

- **Vehicle-Based Road Condition Sensing, Small Business Innovation Research Phase II, Infra-Red Look-Ahead Sensor:** This quarter, Foster-Miller successfully completed laboratory experiments using a special sensor that detects when roadway conditions are dry, wet or icy.

- **Vehicle-Based Road Condition Sensing, Small Business Innovation Research Phase II, In-Tire Traction Sensing System**: Under this project, Luna Innovations has completed research on how to imbed a fiber optic sensor into a tire. This sensor can detect whether there is tire traction with the roadway and to what degree. Eventually this project will be merged with the above-mentioned Infra-Red Look-Ahead Sensor project.

- **Objective Test for Road Departure Countermeasures:** The National Institute of Standards and Testing (NIST) is conducting this project to identify metrics (standards of measurement) and pass/fail criteria for countermeasures against road departure crashes. This quarter, NIST has completed a first draft of the objective tests, which are under review.

- **Field Test of Road departure Countermeasures:** This project is being performed by a partnership among the University of Michigan Transportation Research Institute (UMTRI); Visteon, a spin-off of Ford with integration experience; and Assistware Technologies, a company that develops vision-based systems. The kick-off meeting took place this quarter.

Lane Change Crash Countermeasures: The following projects were active this quarter.

- **On-Road Rural Lane Change Behavior:** Virginia Tech equipped four vehicles with radar detectors to record lane-changing behavior in a rural setting. Nearly 8,000 distinct lane change events were recorded. This quarter, Virginia Tech identified 500 of those events on which they will perform an in-depth analysis.

- **Analysis of TRW, Inc., Urban Lane Change Database:** Similar to the above project but in an urban environment, Mitretek is studying lane change behavior in the Los Angeles area using

laser range data taken by TRW in a prior project. In this quarter, Mitretek and Virginia Tech began coordinating rural and urban efforts. They convened to identify and investigate a common methodology with which to analyze the data.

- **Update of the Lane Change Problem Using 1999 General Estimates System:** This quarter, Volpe has reorganized the data from the 1999 General Estimates System in order to help researchers better identify the maneuvers preceding a lane change crash. The update was completed in February and is currently undergoing review.

- **National Advanced Driving Simulator (NADS) Testing of Lane Change Aids:** When drivers become too dependent on lane changing technologies, they might stop taking necessary precautions. This creates a potentially dangerous situation. NADS is a state-of-the-art simulator located in Iowa that can be used to simulate dangerous situations without hurting anyone. This quarter, Veridian continued developing a detailed test plan for this project.

Crossing Path Crash Countermeasures: Crossing path crashes include all intersection crashes where a turning maneuver is involved, or where straight paths from different legs intersect. . For example, running red lights or turning at intersections can cause such crashes. The following two projects were active this quarter.

- **System to Assess Vehicle Motion Environment (SAVME) Pilot 1 Deployment and Data Analysis:** This pilot project involves a pole-mounted camera hooked up to a computer to record maneuvers at and near an intersection. The recordings help illustrate the factors that cause intersection driving conflicts and crashes to occur. Under this initiative, the NHTSA Vehicle Research and Test Center deployed an SAVEME device in Columbus, Ohio. The data collected from this effort is currently being analyzed, and a report is forthcoming.

- **Analyses Supporting Evaluation of Traffic Control Violation Warning:** Volpe National Transportation Systems Center is developing methods for the operational evaluation of traffic control violation avoidance systems. This quarter, Volpe continued developing the work plan for this initiative.

Pedestrian/ Pedalcyclist Crash Countermeasures: The following project was active this quarter that applies to these types of crashes.

- **Problem Definition for Pedestrians and Pedalcyclist Crashes:** Volpe is working on defining this problem area. This quarter, they completed and submitted the draft final reports, which are now under review.

Multiple Crash Types Research: The following project applies to multiple crash types.

- **Enhanced Digital Maps for Safety:** Another CAMP project involves enhanced digital maps that could be used as an additional sensor for crash avoidance. Such maps are two generations ahead of those available in today's market. The maps are very accurate (degree of accuracy is within 4-10 cm) and they can indicate the location of road edges, road curves, when an intersection is approaching, etc. An annual report will be out soon.